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April 27.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

His Grace the Archbishop of Dublin gave a verbal account of some observations which he had made upon the weather, in connexion with the prognostic drawn from the variations of atmospheric pressure, as indicated by the barometer. The sudden changes of the barometer, his Grace observed, were well known to be connected with corresponding changes of the weather as to rain or drought, and the great and rapid falls with the sudden approach of a gale of wind; but it did not seem to be so generally remarked, that the *slow* and *continuous* changes of the height of the mercury in the barometer were likewise indications of the approach of a season of *long continued* wet or dryness. It was to some connexions of this latter kind, noticed by himself, that he now drew the attention of the Academy. The first of these occurred in the early part of the summer of 1818, when, from the slow and gradual rise of the barometer for the space of ten days, he was led to predict the approach of a long continued dry season. The drought which followed was one of the most remarkable that had occurred in this climate for many years. The second instance of the same kind observed by his Grace was in the early part of the spring of the present year. On the 17th of February the barometer commenced to rise, but very slowly, and the rise continued for six or seven days; he was thus led to expect a long continuance of dry weather; and the result, as is well known, fully verified the anticipation, the change being followed by more than three weeks, during which there was not a single drop of rain, and that too at a season of the year usually wet.

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The Secretary read a notice by Mr. George Knox on the

subject of the Contact Theory of Electricity, as connected with the views suggested in his paper “on the Direction and mode of Propagation of the Electric Force, in media not undergoing Electrolyzation.” Mr. Knox referred, at some length, to the recent experiments of M. Peclet on this subject, published in the *Annales de Chimie*.

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The Secretary read some memoranda of the native Indian account of Tabasheer, communicated by William Farran, Esq.

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The Secretary read the continuation of a paper by James Orchard Halliwell, Esq., F.R.S., F.S.A., &c. &c., on the Boetian numerical Notation.

### I.

*An Inquiry into the Period of the first Use of the Zero by those Writers who adopted the Notation of the Boetian numerical Contractions.*

During the researches made by M. Chasles, of Chartres, and myself, on the subject of the Boetian numerical contractions,—the former published in the Transactions of the Brussels Academy, and the *Comptes Rendus* of the Academy of Sciences, the latter in an Appendix to the *Rara Mathematica*,—we came to no definite conclusion on the nature of the change from the use of the abacus to that of local position and the cipher. Some documents recently discovered by me have strikingly elucidated this point of the inquiry, and as they develop an entire new view of a system before only conjectural, I have ventured to place the results before the notice of the Royal Irish Academy, the more especially as the general objects of that body render the subject more appropriate to their views than those of any society in England.

Before I enter into this short discussion, to give the reader an idea of the state the subject was left in, I will quote my latest opinion:—

"It would be impossible, with the few materials yet brought to light, to conjecture with any great probability how far these Boetian contractions may have influenced the introduction, or cooperated with the Arabic system to the formation of our present numerical notation. It appears to me highly probable that the two systems became united, because the middle age forms of the figure *five* coincide with the Boetian mark for the same numeral, and those of two others are very similar. The idea of local position, again, may have had an independent European origin; the inconveniences of the abacus on paper would have suggested it by destroying the distinguishing boundaries, and inventing an arbitrary hieroglyphic for the representation of an empty square."—*Rara Mathematica*, p. 111.

Now, from the Mentz MS. in the Arundel Collection, it is very evident that their mode of operation with the abacus had received one great improvement on the Greek and Roman system, the abolishing the necessity of motion, and only using the table *cum pulvere*, as a means for distinguishing position. Thus, in the following addition sum, using the names instead of the cabalistic characters, we have an example of their method of proceeding:—

Andras	Igin	Calcis	Andras
Tenis	Arbas	Ormis	Celentis
Celentis	Calcis		Igin

Thus making a total of— celentis, calcis, zero, igin. Now, it is evident, that in order to do away with the necessity of this table, supposing the contractive marks again substituted for the latter words, we have only to imagine an arbitrary character for the deficiency under the *ormis*, and the *modus operandi* is synonymous with our own present form.

The following are new instances of the appearance of the zero without its use :—

MS. Hatton. 7, we find the following passage :—" inscribitur et in ultimo figura 0, si pos nomine. Quæ licet numerum nullum significet: tum ad alia quædam utilis est."

MS. Lansd. 842, is a contractive mark for a si pos, outside the drawing of the abacus.

MS. Hatton. 112. The si pos is given with its contraction, but is only used to fill up the space in the abacus.

Now, at the last page of a very beautiful MS. of the translation of Euclid, by Athelard, of the fourteenth century, and in the *explicit* of the fifteen books, the number 15 is written in these singular contractions, and without a division. This MS. is in the Arundel Collection of MSS., and was accidentally discovered by me when looking into it for another purpose.

The new face thus put upon the question of their gradual identity with the present system, and the satisfactory evidence that the latter portion of my former conjecture is correct, is sufficient almost to make me bold enough to venture on the truth of the previous one. It must be recollected, however, that on the last point one document only has yet been discovered.

## II.

*The middle-age Knowledge of the Alabaldine Notation considered as an Argument in Favour of the early Introduction of the Boetian Zero into Western Europe.*

I beg leave to make the following additional observations in corroboration of what was stated by me on the same subject in a paper read before the Academy on the 13th of January.

The recent dispute\* between M. Chasles and M. Libri,

\* An account of the whole discussion may be found in the *Comptes Rendus Hebdomadaires* of the Academy of Sciences, for the 7th and 14th of October last, pp. 447-454, and pp. 463-472.

before the French Institute, relative to the bearing of certain points in my Essay on the Boetian contractions, has not established a single important fact, save that the knowledge of local value was apparent in the *integral* abacal operations of these contractions. On the question of the period of the introduction of the Boetian zero, confessedly the most curious and difficult point to be established, none of the continental writers, M. Chasles, M. Libri, or M. Vincent, have ventured on more than random conjectures.

The Boetian fractional notation, or the Alabaldine notation,\* was first explained in the above-mentioned Essay, previously to which no rational conjectures respecting them had been made. I am now enabled to prove that this notation was not only recognized, but commonly employed throughout the middle ages.

A passage at the end of the second book of "Boetii Geometria," *de minutis*,† proves that the system was contemporary with that writer. Bede, in his Treatise on Arithmetic, has given a whole chapter to it. Next comes the Arundel MS.‡ of the twelfth century, from which I am enabled to give a most exceedingly curious specimen of their *modus operandi* :—

QUESTION.§ It is required to multiply *semis* ( $\frac{1}{12}$ ) into *siliqua* ( $\frac{1}{144}$ ): What is the result?

SOLUTION. *Semis* = *as . semiuncia*, but *as* = *igin*; therefore, *semis* = *igin . semiuncia* = *semiuncia*; because *igin* is the Boetian unity.

\* So called from its presumed inventor.

† MS. Lansd. 842, B. &c.

‡ No. 343, in the British Museum.

§ It is almost unnecessary to observe that this is much simplified and abridged from the MS.

Now  $\text{scrupulus} = \frac{\text{calcis}}{\text{calcis}} \cdot \text{scrupulus}$ ; because  $\frac{\text{calcis}}{\text{calcis}} = \text{igin}$   
 $\therefore \text{scrupulus} = \text{calcis} \cdot \frac{\text{scrupulus}}{\text{calcis}}$ .

But  $\frac{\text{scrupulus}}{\text{calcis}} = \text{siliqua} \therefore \text{scrupulus} = \text{calcis} \cdot \text{siliqua}$ .  
and  $\text{semis} \cdot \text{siliqua} = \text{semis} \cdot \frac{\text{scrupulus}}{\text{calcis}} = \text{semiuncia} \cdot \frac{\text{scrupulus}}{\text{calcis}}$   
 $= \text{semiuncia} \cdot \frac{\text{igin}}{\text{calcis}} \cdot \text{scrupulus}$ .

But, by the integral notation,  $\frac{\text{igin}}{\text{calcis}} = \frac{\text{andras} \cdot \text{igin}}{\text{andras} \cdot \text{calcis}} =$   
 $\frac{\text{igin}}{\text{andras}} \cdot \frac{\text{andras}}{\text{calcis}} = \frac{\text{igin}}{\text{andras}} \cdot \frac{\text{igin}}{\text{ormis}} = \text{semiuncia} \cdot \text{duella}$ .

Therefore,  
 $\text{semis} \cdot \text{siliqua} = \text{semiuncia} \cdot \text{semiuncia} \cdot \text{duella} \cdot \text{scrupulus}$ .

We have now to reduce the

$\text{semiuncia} \cdot \text{semiuncia} = \frac{\text{igin}}{\text{andras}} \cdot \frac{\text{igin}}{\text{andras}} = \frac{\text{igin}}{\text{arbas}} = \text{sicilius}$ .  
and,  $\text{semis} \cdot \text{siliqua} = \text{sicilius} \cdot \text{duella} \cdot \text{scrupulus}$ .

We have thus the required quantity in a very complicated form. To effect the reduction of this is the work of another long operation, which it is unnecessary to repeat here, as the above will sufficiently serve for an example of the laborious, though ingenious, plan which was pursued.

Gerbert, in his Treatise on Geometry,\* makes use of this notation, and adds, *quod abacistæ facillimum est.*† The MS. Burney, 213, in the British Museum contains an express treatise on it. Added to which, the Alabaldine contractions are constantly occurring in mathematical manuscripts, and till very lately no one had the slightest idea of their true nature.

\* Pezzi Thesaurus, t. i. p. ii. col. 13.

† Ib. col. 30.

That the writers on the Boetian contractions could have accomplished the solution of intricate fractional questions (entirely dependent on the principle of local position) without the knowledge of the zero, or some arbitrary character to express its situation, appears to me to be quite impossible. Above all, it must be remembered that the abacus was *not* employed with the Alabaldine notation.

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A paper was read by William R. Wilde, Esq., on the animal remains and antiquities recently found at Dunshaughlin, in the county of Meath.

Surgeon Wilde prefaced his observations by stating, that the communication which he was about to make, on the subject of the vast collection of bones which were recently discovered in the county of Meath, was but introductory to a more detailed description of their zoological and anatomical characters which he purposed bringing before the Academy at a future meeting. But, having had several opportunities of visiting the spot where these remains were found, and having collected some information upon the subject from the persons who superintended, and others who were actually engaged in making the excavations, he felt it necessary to lay before the Academy a popular description of the place,—in order to show under what circumstances these bones were found, and to enable the members present to form some idea as to the nature of this very remarkable collection. In addition to this statement of facts, he would likewise exhibit several of the antiquities found in connexion with the animal remains, in the hope that the antiquary and the historian might, from their examination, be enabled to arrive at some probable conclusion as to the date of the construction of this place.

The following is an extract of Mr. Wilde's statement :  
“ About a mile to the east of the village of Dunshaughlin,

on the townland of *Lagore*, and near the margin of a 'cut-away' black bog, is a circular mound, slightly raised above the surrounding plain, its highest central part being about eight feet above the margin, and the circumference of the mound measuring 520 feet. A small stream passes through this circle ; and the whole bog in which it is situate occupies a slight concavity of about a mile and half in circumference, bounded by raised tillage and pasture lands. Within the memory of some of the old inhabitants of the neighbourhood, this bog was covered with water during the greater part of the year, and it is so invariably during winter, up to the present period. A large pond is still in existence in one of the fields adjoining the mound. (Mr. Wilde exhibited a map of the mound and the surrounding country.) A few years ago, some labourers, while clearing the stream-way, discovered several bones protruding from its sides ; and in May, 1839, the quantity of bones found in the drain was so great, and their value so well known, that a further examination was made, when it was discovered that the greater part of the mound was composed of the remains of animals, placed there in the following manner :

" The circumference of the circle was formed by upright posts of black oak, measuring from six to eight feet in height ; these were morticed into beams of a similar material, laid flat upon the marl and sand beneath the bog, and nearly sixteen feet below the present surface. The upright posts were held together by connecting cross beams, and fastened by large iron nails ; parts of a second upper tier of posts were likewise found, resting on the lower ones. The space thus inclosed was divided into separate compartments, by septa or divisions that intersected one another in different directions ; these were also formed of oaken beams, in a state of great preservation, but joined together with greater accuracy than the former, and in some cases having their sides grooved or *rabitted* to admit large pannels driven

down between them. The interior of the chambers so formed were filled with bones, and black moory earth, and the heap of bones was raised up in some places within a foot of the surface. It was generally found that the remains of each species of animal were placed in separate divisions, with but little intermixture with any other; and the antiquities, &c., were found along with them, without any order or regularity, but for the most part near the bottom."

The most numerous class of bones were those of oxen, and of these Mr. Wilde exhibited the heads of several varieties, in a state of great perfection. Some of these were identical with those which formed the subject of Mr. Ball's communication to the Academy, in January, 1839, and which were discovered in the bogs of Westmeath, Tyrone, and Longford; others bore a strong resemblance to them.

There were other specimens of these oxen which, although of rather diminutive size, equalled, as to beauty of head and horn, the modern improved breed of the English short-horned Durham, and the middle horned Devon and Ayshire,—being distinguished by the peculiarities of the head, and in particular of the *slug* or *core* on which the horn is moulded, and which had remained quite perfect, although the cuticular horn had been destroyed.

A fourth variety was that which has been denominated the true Irish cattle,—the long-horned, or crumple-horned, the improved large breed of which still exists in some of the midland counties of Ireland, particularly Roscommon. In this variety there is a very remarkable projection of the upper portion of the frontal bone between the horns, which latter turned downwards, and a little backwards, somewhat in the manner of the Craven or Lancashire stock.

There were also several heads of the *polled* or hornless variety, called in this country *mhaol*, exhibiting some slight differences as to the fineness of their heads, but in general resembling the Galloway and Angus breeds.

All these heads differ from those figured in Cuvier's *Ossemens Fossiles*; and Mr. Wilde regretted that he was at present unable to draw the necessary comparisons between the existing breeds and those found at Dunshaughlin, from the want of a collection of the heads of the former in the museums of this country, and from our not possessing any work having accurate plates of the anatomical characters of the horned cattle, although it is upon such characters that the zoologist and the cattle-breeder found their distinctions. A great number of these heads are broken in the centre of the forehead, as if by some blunt instrument—apparently the mode of slaughter. It might naturally be expected that the best breeds and the largest assemblage of these animals should be found (even at an early period) upon the fertile and extensive plains of Meath; and the whole collection offers an incontestible proof, that at a remote period Ireland possessed not only *several varieties* of horned cattle, but also breeds analogous to those most valued in England at the present day, and lately re-introduced into this country.

The animal, whose remains were found in the greatest abundance next to the ox, was the pig—several of the heads of which were produced, of all ages and sizes, but of a smaller description than those at present bred in this country.

There were one or two specimens of the horse and ass. The bones of a number of deer were likewise found in the collection, both male and female. The former, some of the antlers of which are quite perfect, prove the race to have been the common deer; and in no instance were the horns of the Fallow deer found—verifying the general opinion of naturalists, that the latter are an introduced race into this country. Large quantities of the bones of goats of all ages were dug up. The head of a *four-horned* sheep was also discovered in the same locality, of a peculiar form, to be described hereafter; this was the only instance of the sheep that Mr. Wilde had been able to procure.

Some of the most remarkable remains found in this inclosure were those of a very large and powerful dog, apparently belonging to an animal of the *grey-hound* tribe, but of enormous size—the heads measuring, in the dry bone, nearly eleven inches in length, and principally characterized by the great extent and magnitude of the occipital crest, and the projecting muzzle. Mr. Wilde stated it as his opinion, that we had now, for the first time, an opportunity of judging of the form and characters of the dogs denominated *Irish wolf dogs*, to which breed he considered these heads to have belonged. There were also several foxes, but no wolves. With these remains were mixed up the shells of limpids and buccinums; and a few bones of birds; some portions of *burned* bones, and large quantities of hazel nuts. Most of the bones of the larger ruminants were unbroken; and upwards of 150 cart-loads of bones have been already dug out of this inclosure, and have been forwarded to Scotland for manure, none of them being in a fossil state.

Nearly in the centre of the heap, and within two feet of the surface, were discovered two human skeletons, lying at length, and without any surrounding wood or stone work, &c. The superstitions of the people who were employed in making the excavation, led them to re-deposit 'them in the neighbourhood, and they cannot now be obtained; but Mr. Wilde produced some of the vertebræ, and the frontal bone of one of these bodies, and remarked upon the similarity of the latter to other heads found in ancient Irish monuments, and in particular its striking analogy to those found in the Cromleigh recently opened in the Phoenix-park.

The antiquities found in this place may be divided into the warlike, the culinary, and the ornamental. They consisted of *iron* swords of different lengths, with straight edges and angular points, and bearing a resemblance to the ancient Roman swords. Very many knives were found, of different shapes and sizes, with iron spear, javelin, and dagger blades,

and part of the boss or central ornament of a shield ; but *no brazen weapons* of any description. Two querns, or ancient corn mills, were found on the marl, at the bottom of the inclosure ; sharpening stones ; iron chains ; an iron ax ; a brazen pot, and three small brass bowls of most elegant shape and workmanship ; several articles precisely resembling miniature frying pans, of about three inches in diameter (perhaps incense burners) ; circular discs of turned bone, wood, and slate, like those supposed to have been used at the end of the distaff ; small shears, like the modern sheep shears ; brazen, bone, and iron pins, from four to six inches in length—the former of great beauty of construction ; brooches, and parts of buckles, containing pieces of enamel and mosaic work ; bracelets ; wooden (yew tree) combs, tooth-picks, etwees, and other articles belonging to the toilette. Several of these articles show an extraordinary state of perfection of the arts at the period of their construction.

A very curious bone was likewise found, and exhibited to the meeting, with a number of devices carved on it, as if by way of practice in engraving ; these devices consisted of scrolls and marks precisely similar to those formed on ancient Irish crosses, ornaments, and grave-stones. There were no crosses, beads, or *Christian* sacred ornaments found in the excavation ; but a number of pieces of stags' horns sawn across, and also pieces of hazel wood, in great quantity, as if laid up for fire-wood, were found in one spot near the bottom.

On the surface of the mound, but apparently without any connexion with it, a groat of Robert the Second, of Scotland, was picked up.

Some of the articles exhibited now belong to the collection of the Dean of St. Patrick's ; but the greater number were forwarded for the inspection of the Academy, by Mr. Barnwall, of Grennanstown, on whose ground the discovery was made, and to whom Mr. Wilde was indebted for the bones, and permission to make any researches he might require.

Mr. Wilde concluded by impressing on the Academy the importance of appointing persons to inquire into this and such other objects of antiquarian interest as might, from time to time, come to their knowledge, and thereby preserving them to the Academy and to science ; and he read a letter from Mr. Barnwall, offering every facility to the Academy, or to any of its members, to make further investigations into the bone-heap at Lagore.

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The thanks of the Academy were voted to Mr. Barnwall, for his obliging offer.

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IT WAS RESOLVED, (on the recommendation of Council,) to omit the words in Chapter II. Sect. 5, of By-laws, following the words " each candidate proposed."

#### DONATIONS.

*A Spear Head.* Presented by Sir W. Betham.

*An Examination of the Ancient Orthography of the Jews, and of the original State of the Text of the Hebrew Bible.* By Charles W. Wall, D.D., M. R. I. A. Presented by the Author.

*Ordnance Map of the County of Wicklow,* in Forty-nine sheets, including Title and Index. Presented by His Excellency the Lord Lieutenant.

*Burgh Records of the City of Glasgow.* By John Smith, Esq. Presented by the Author.

*Journal of the Franklin Institute.* Vol. XXIV. for 1839. Presented by the Society.

*Proceedings of the American Philosophical Society,* Vol. I. Nos. 9 and 10. Presented by the Society.

*Quarterly Journal of the Statistical Society of London,* Vol. III. Part 7. Presented by the Society.